

U.S. Patent Application Serial No.09/635,116
Attorney Docket No. 05516.056002

IN THE CLAIMS:

Please amend the claims as follows.

- 1-9. (Cancelled)
10. (Currently Amended) A method for designing a roller cone bit balancing axial forces acting on each one of a plurality of roller cones on a roller cone drill bit during drilling, comprising:

simulating the drill bit drilling through an earth formation, the simulating comprising:

determining, based on a means for determining an axial force, calculating, from a geometry of cutting elements on each of the roller cones and at least one characteristic of an earth formation simulated as being drilled by the drill bit, an axial force acting on each of the cutting elements,

determining the axial force acting on each of the roller cones, based on the axial force acting on the cutting elements;

simulating incrementally rotating the bit and recalculating redetermining the axial forces acting on each of the cutting elements;

repeating the incrementally rotating and recalculating redetermining for a selected number of simulated incremental rotations;

combining the axial force acting on the cutting elements on each one of the roller cones; and

adjusting at least one bit design parameter, and repeating the simulating and adjusting until a difference between the combined axial force on each one of the roller cones is less than a difference between the combined axial force determined prior to

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adjusting the at least one initial design parameter.

11. (Cancelled)

12. (Cancelled)

13. (Cancelled)

14. (Previously Presented) The method as defined in claim 10 wherein the ~~at least one bit design parameter adjusting~~ comprises changing a number of cutting elements on at least one of the cones.

15. (Previously Presented) The method as defined in claim 10 wherein the ~~at least one bit design parameter adjusting~~ comprises changing a location of cutting elements on at least one of the cones.

16-24. (Cancelled)

25. (Presently Amended) A method for ~~optimizing a designing~~ of a roller cone drill bit, comprising:

simulating the bit drilling through an selected earth formation, wherein the simulating comprises determining an axial force on a cutting element, based on a means for determining an axial force, determining an axial force on the roller cones, based on the axial forces on the cutting elements, and angularly rotating the bit;

adjusting at least one design parameter of the bit;

repeating the simulating the bit drilling; and

comparing a distribution of axial forces among the roller cones prior to the adjusting the at least one design parameter with a distribution of axial forces among the roller cones after adjusting the at least one design

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~~parameter, repeating the adjusting and simulating until a distribution of an axial force on the bit is substantially balanced between the roller cones.~~

- 26-28. (Cancelled)
29. (New) The method of claim 25, further comprising graphically displaying a representation of axial forces on the roller cones.
30. (New) The method of claim 25, wherein the adjusting comprises changing an orientation of at least one cutting element.
31. (New) The method of claim 25, wherein a designer compares the distribution of axial forces.
32. (New) The method of claim 10, wherein adjusting comprises changing an orientation of at least one cutting element.
- D | 33. (New) The method of claim 10, wherein the adjusting and the repeating are continued until a distribution of axial force is substantially balanced between the roller cones.
34. (New) A method for designing a roller cone bit, comprising:

simulating the drill bit drilling through an earth formation, the simulating comprising:

obtaining an axial force acting on each of the cutting elements;

determining the axial force acting on each of the roller cones, based on the axial force acting on the cutting elements,

angularly rotating the bit and reobtaining the axial forces acting on each of the cutting elements, and repeating the rotating and reobtaining for a number of rotations;
and

adjusting at least one bit design parameter, and

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repeating the simulating and adjusting until a difference between the axial force on each one of the roller cones is less than a difference between the axial force determined prior to adjusting the at least one bit design parameter.

35. (New) The method of claim 34, wherein adjusting comprises changing an orientation of at least one cutting element.

36. (New) The method of claim 34, wherein the adjusting and the repeating are continued until a distribution of axial force is substantially balanced between the roller cones.

37. (New) The method of claim 34, further comprising graphically displaying a representation of axial forces on the roller cones.

38. (New) A method for designing a roller cone bit, comprising:

simulating the drill bit drilling through an earth formation, the simulating comprising determining, based on a means for determining an axial force, an axial force acting on each of the cutting elements, and determining the axial force acting on each one of the roller cones, based on the axial force acting on the cutting elements, angularly rotating the bit and redetermining the axial forces acting on each of the cutting elements and redetermining the axial force acting on each one of the roller cones;

repeating the rotating and redetermining for a number of rotations; and

adjusting at least one bit design parameter, and

repeating the simulating and adjusting until a difference between the axial force on each one of the roller cones is less than a difference between the axial force determined prior to adjusting the at least one initial design parameter.

39. (New) The method of claim 38, wherein adjusting comprises changing an orientation of at least one cutting element.

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40. (New) The method of claim 38, wherein the adjusting and the repeating are continued until a distribution of axial force is substantially balanced between the roller cones.

41. (New) The method of claim 38, further comprising graphically displaying a representation of axial forces on the roller cones.

42. (New) A method for designing a roller cone bit, comprising:

simulating the drill bit drilling through an earth formation, the simulating comprising:

obtaining an axial force acting on each of the cutting elements,

obtaining the axial force acting on the cutting elements on each one of the roller cones, based on the axial forces acting on the cutting elements,

angularly rotating the bit and reobtaining the axial forces acting on each of the cutting elements,

repeating the rotating and reobtaining for a number of rotations, and

adjusting at least one bit design parameter, and repeating the simulating and adjusting until a rate of penetration on the bit is increased in comparison to a first simulation of the drill bit.

43. (New) A method for designing a roller cone drill bit, comprising:

simulating the bit drilling through an earth formation, wherein the simulating

comprises obtaining an axial force on a cutting element, determining the axial force acting on each one of the roller cones, based on the axial forces acting on the cutting elements, and angularly rotating the bit;

adjusting at least one design parameter of the bit;

repeating the simulating the bit drilling; and

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comparing a distribution of axial forces acting on the roller cones prior to the
adjusting with a distribution of axial forces acting on the roller cones after adjusting.

44. (New) The method of claim 43, wherein adjusting comprises changing an orientation
of at least one cutting element.

45. (New) The method of claim 43, further comprising graphically displaying a
representation of axial forces on the roller cones.

46. (New) The method of claim 43, wherein a designer compares the axial forces.